PROC. BIOL. SOC. WASH.
90(3), pp. 459–482

THE SORICIDAE OF TAIWAN

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The Soricidae of Taiwan are represented by *Suncus* and *Crocidura* in the Crocidurinae and *Anourosorex*, *Chimarrogale*, and *Episoriculus* in the Soricinae. These shrews were collected at various localities on Taiwan and we have made some observations concerning their habits, distribution and systematics.

Little has been published about Taiwan soricids other than checklists (e.g. Kuroda, 1938; Chen, 1956) and fragmentary records. Only Tanaka (1936) considered the distribution and habitats of the insectivores. Kuroda (1952) discussed the zoogeographical affinities of the soricids as well as the other species on the island.

Material was collected during visits from 1963 to 1969 in Taipei Hsien, Taichung Hsien, Nantou Hsien, Hualien Hsien, and Chiai Hsien. Further information about the species was obtained from the collection in the U.S. National Museum of Natural History (USNM), Washington, D.C. and from the literature. Unless otherwise indicated, distributional records and measurements are based on our collections (deposited in the USNM and the University of California, Davis), those of the late Professor Sherman A. Hoslett (deposited in the University of California, Davis), and those in the USNM. We follow Repenning (1967) in the allocation of genera to subfamilies.

All measurements, taken with dial calipers, are in millimeters (mm). Most are self explanatory. External measurements are those from the specimen tags; hind foot lengths include the claw. Palate length is from the front edge of the premaxilla, viewed ventrally, to the posterior edge of the palatine. Length of the upper tooth row (UTR) is from the front edge of the incisor to the posterior edge of M3. Height of the braincase is from the highest point of the sagittal crest to the basisphenoid-basioccipital suture. Length of the lower tooth row (LTR) is from the posterior edge of of m3 to the anterior edge of pm1. Height of rostrum is from the alveolus of I3 to the top edge of the rostrum. Length of mandible is from the tip of the incisor to the tip of the articular condyle. PM1 and I1 is the greatest length of the respective cingulum, viewed laterally. Terminology follows Meester (1963). The colors were measured under a common light source with a Munsell Soil Color Chart; when cited, the Munsell terms are capitalized.

Comparative specimens were borrowed from the American Museum of Natural History, New York (AMNH), USNM, National Science Museum,

Tokyo (NSMT), Field Museum of Natural History, Chicago (FMNH), British Museum (Natural History), London (BMNH), Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), and B. P. Bishop Museum, Honolulu (BPBM).

Crocidura attenuata tanakae Kuroda

Sorex sp.
Swinhoe, 1864:382; Aoki, 1913:270, 1914:30.
Crocidura attenuata Milne-Edwards, 1872
Chen, 1948:43; Jones, Lim and Cross, 1971:270; Jones, 1975:185.
Chodsigoa sodalis Thomas, 1913
Kuroda, 1935:287 (misident.).
Crocidura sp.
Tanaka, 1936:312; Harrison and Audy, 1951:179.
Crocidura tanakae Kuroda, 1938
Kuroda, 1938:81, 1940:178; Okada, 1938:2; Chen, 1956:48; 1969:349.
Crocidura attenuata tanakae Kuroda, 1938
Kuroda, 1952:286; Ellerman and Morrison-Scott, 1951:83, 1966:83; Jones, Huang and Chang, 1969:49; Kuntz and Dien, 1970:33.

This shrew was first described from Taiwan as a new species, *C. tanakae* Kuroda, 1938. The subspecies is found from sea level to at least 1,225 m at Wushe, Nantou Hsien. It occurs commonly in cane fields west of the city of Taichung in loose, sparse litter under shrubs and small trees but appears to be more common in uncultivated rocky patches amid dense tangles of bushes and bamboo. *C. attenuata* was the most commonly caught mammal in an overgrown cultivated field near Wushe. This shrew was also collected in a cornfield at Wushe, in a weed field near Wanta, in secondary streamside growth near Meichi, and in seaside scrub vegetation and cultivated fields near Tamsui.

Females with two and three embryos were found in February.

The left upper unicuspids of USNM 358668 from Tamsui and the third upper unicuspid of USNM 358662 from Wushe are all missing with no apparent alveoli.

Measurements.—Total length males (6 specimens) mean = 136.5 mm (range = 129–142), females (7) 133.4 (126–141); tail males (7) 52.9 (49–57), females (8) 51.8 (50–55); hind foot males (7) 13.3 (12–14), females (9) 13.7 (13–15); greatest length of skull males (6) 20.5 (19.6–21.1), females (7) 20.5 (20.2–21.0); palatal length males (6) 8.6 (8.0–8.9), females (8) 8.5 (8.4–8.7); greatest breadth braincase males (6) 9.2 (8.8–9.4), females (8) 9.1 (8.9–9.4); length upper tooth row males (6) 9.2 (8.8–9.5), females (9) 9.0 (8.9–9.2); greatest maxillary width males (7) 6.6 (6.3–6.9), females (9) 6.6 (6.4–6.8).

Specimens examined (17 total).—Taipei Hsien: Tamsui 25°10′N, 121°26′E (USNM 358668). *Taichung Hsien*: Ma-an Liao, 6 mi S Tung Hsi 24°15′N, 120°49′E (USNM 294129). *Nantou Hsien*: 3 km E Wushe 24°02′N, 121°08′E (USNM 358109, 358110, 358660, 358111); 1.7 km W Wushe (USNM 358661); Taita Agricultural Farm, 5.6 km E and 1.4 km N Wushe (USNM 358662); Lung Yuen Bridge, Wushe (USNM 332814); 2 km E Wanta 23°58′N, 121°08′E (USNM 358112); Meichi, 4.5 km SW Wushe 24°01′N, 121°06′E (USNM 358113, 358665, 358667); Meichi, 3.5 km SW Wushe (USNM 358663, 358664); Meichi, 2.5 km SW Wushe (USNM 358114, 358666).

Literature records.—Taipei Hsien: Taihoku (now Taipei) 25°03′N, 121°30′E (Tanaka, 1938). *Taichung Hsien*: Taichu-shi (now Taichung) 24°09′N, 120°41′E (Kuroda, 1938). *Chiayi Hsien*: Kagi (now Chiayi) 23°29′N, 120°27′E (Kuroda, 1938; Tanaka, 1938). *Nantou Hsien*: Horigai (now Puli) 23°58′N, 120°57′E (Kuroda, 1952); Suiriko (now Shui-Li-K'eng) 23°49′N, 120°51′E (Kuroda, 1938); Shoho-sha (now Hsiao-Pu) 24°01′N, 120°57′E (Kuroda, 1938).

Crocidura horsfieldi kurodai, new subspecies

Crocidura horsfieldi tadae Tokuda and Kano, 1936
Kuntz and Dien, 1970:33.
Crocidura sp.
Jones, Lim and Cross, 1971:271.

Holotype.—Adult female, skin and skull, USNM 358115, from Linkou, Taipei Hsien, Taiwan; obtained January 1969 by Gwilym S. Jones, original no. T1451. First upper incisors broken.

Diagnosis.—Distal ends of dorsal hairs vary from Dark Reddish Brown to Very Dark Brown with Dark Gray bases. Differences in color from base to tip cause grizzled appearance. Ventral fur ranges from Gray to Very Dark Gray and is same color at base as at tip. Dorsum and venter evenly colored throughout. Rather sharp demarcation between dorsal and ventral colors. Tail unicolored in type, USNM 358115, and in immature USNM 311473. USNM 332813, however, has slightly bicolored tail. All have typical bristles on basal ⅓ of tail. Hind feet gray brown, although USNM 332813 has more gray and less brown than others. Vibrissae of all three specimens are brown, Dark Brown on 358115, Medium Brown on other two specimens, and evenly colored throughout. Length of palate short, rostrum relatively massive; upper tooth row relatively short; braincase relatively narrow; posterior edge of palatine narrow.

Measurements.—Holotype plus one unsexed skin. Total length mean = 104 mm (range = 97–110); tail 44 (42–46); hind foot 12 (12); palatal length 6.3 (6.1–6.5); greatest breadth braincase 7.7 (7.7); length upper tooth

row 7.1 (7.0–7.2); greatest maxillary width 5.2 (5.1–5.3); least interorbital breadth 3.7 (3.7); height of braincase 4.2 (4.2); length of lower tooth row 5.2 (5.0–5.3), length of PM4 at cingulum 1.8 (1.7–1.8), width of posterior edge of palatine 2.1 (2.1), length of nasals 4.8 (4.8); height of rostrum at I3 1.8 (1.7–1.9); length of I1 at cingulum 1.2 (1.0–1.3); distance from infraorbital foramen to anterior point of premaxilla 4.4 (4.4).

Comparison.—Crocidura horsfieldi kurodai is a medium sized *C. horsfieldi*, the external measurements being closest to *C. h. indochinensis* from Burma (Table 1). It is smaller than *C. h. watasei*, Ryukyu Islands, and larger than *C. h. tadae*, Lan Yu Island, Taiwan and *C. h.* ssp., Fukien. There is general gradation in size from the smallest, *C. h. tadae*, through *C. h. kurodai*, *C. h. indochinensis*, *C. h. horsfieldi* to *C. h. watasei*.

The type of *C. h. kurodai* and USNM 311473 are closest in dorsal color to *C. h. watasei*, whereas USNM 332813 is closer to *C. h. horsfieldi* and those *C. h. indochinensis* from Burma. *C. h. tadae* (NSMT 4395) has a Dark Reddish Brown dorsum, but unlike *C. h. kurodai* and the other subspecies studied, which have a grizzled color due to bicolored dorsal hairs, it has a solid rusty color due to unicolored hairs. *C. h. tadae* was described by Tokuda and Kano (1936) as having a uniform gray dorsum with buffy brown and clove brown variations. None of these pelage colors appears to be close to those of *C. h. kurodai*. *C. h.* ssp. from Fukien also has unicolored dorsal hairs, but they are Black.

The ventral pelage of *C. h. kurodai* is Gray to Very Dark Gray. This condition is closest to *C. h. indochinensis* from Burma and *C. h. watasei* which have Grayish Brown and Dark Gray venters. *C. h. tadae* has a Dark Reddish Brown venter which was described by Tokuda and Kano (1936) as slightly paler than the dorsum and more silvery. The *C. h.* ssp. from Fukien has a Very Dark Grayish Brown venter.

As with all *C. horsfieldi*, *C. h. kurodai* has bristles on the proximal third of the tail, a character noted by Tomes (1857) in the original description of *C. horsfieldi* and mentioned both by Robinson and Kloss (1922) in the description of *C. h. indochinensis* and by Tokuda and Kano (1936) for *C. h. tadae*.

The type-specimen of *C. h. kurodai* has a monocolor tail as does USNM 311473. The tail color is seen elsewhere only in the specimen of *C. h.* ssp. from Fukien. *C. h. tadae* (NSMT 4395) has a tail which is only slightly bicolored, a characteristic observed in specimen USNM 332813 of *C. h. kurodai*. Tokuda and Kano (1936) reported that *C. h. tadae* has a tail so slightly bicolored that ". . . it cannot be said to be bicolored . . . ." All specimens from the other localities have bicolored tails.

The vibrissae of *C. h. kurodai* as well as the specimens of *C. h. watasei*, *C. h. indochinensis*, and *C. h. horsfieldi* are unicolored, generally brown.

However, the distal half of the vibrissae of *C. h. tadae* are white (Tokuda and Kano, 1936), a characteristic not noted in specimen NSMT 4395.

The palatal length of *C. h. kurodai* is shorter than any of the other *C. horsfieldi*. The length of the nasals is markedly shorter than in *C. h. tadae* and *C. h. watasei* but comparable to that of *C. h.* ssp. from Fukien, *C. h. indochinensis* from Tonkin and *C. h. horsfieldi*. The length of the upper tooth row is shorter than that of *C. h. tadae*, *C. h. watasei*, and *C. h. indochinensis* but comparable to that of *C. h. horsfieldi* and the Fukien specimen. The posterior edge of the palatine of *C. h. kurodai* is narrower than in any *C. horsfieldi* although it is close to that of *C. h. horsfieldi* and *C. h. tadae*.

The height of the rostrum is comparable to all but *C. h. tadae*, which is not as high. In conclusion, the rostrum of *C. h. kurodai* is most similar in size to the *C. h.* ssp. from Fukien. It is shorter and somewhat more robust than that of *C. h. tadae*.

Breadth of the braincase is less than in all but *C. h. horsfieldi* and *C. h.* ssp. from Fukien. The least interorbital breadth of *C. h. kurodai* is narrower than in *C. h. tadae* and *C. h. horsfieldi*, but close to that of other subspecies examined.

C. h. kurodai is generally smaller than *C. h. watasei*, the largest *C. horsfieldi* studied, and, is most similar to *C. h. horsfieldi* and *C. h.* ssp. from Fukien, although the latter is much darker. *C. h. kurodai* can be distinguished from *C. h. tadae* by its generally smaller cranial measurements and grizzled Dark Reddish Brown (or grizzled Very Dark Brown) dorsal color in contrast to the solid, rustier Dark Reddish Brown of *C. h. tadae*; in addition, the rostrum of *C. h. kurodai* is shorter and more robust, and the ramus is relatively stout (Fig. 1A).

Shou et al. (1966) described *C. h. wuchihensis* from Hainan. The description suggests a typical *C. horsfieldi* but offers little with which we can compare our specimens.

C. h. myoides from Kashmir was not examined.

Remarks.—The relationships of *C. h. kurodai* appear rather clear except for *C. h. tadae* and *C. h.* ssp. from Fukien; both of the latter differ from *C. h. kurodai* but are represented by only one specimen each. The mainland specimens, *C. h. indochinensis*, exhibit considerable variation (Table 1) which indicates need for revision of this subspecies when more specimens are available. Five of the six named subspecies are insular, emphasizing the high degree of endemism among shrews (Repenning, 1967).

Etymology.—This subspecies is named to honor Nagamichi Kuroda in recognition of his extensive studies of mammals of eastern Asia.

Specimens examined.—Three, as follow: *Taipei Hsien*, Linkou (USNM 358115); *Nantou Hsien*, Lung Yuen Bridge 24°02'N, 121°08'E (USNM 332813); "Formosa" (not specific) (USNM 311473).

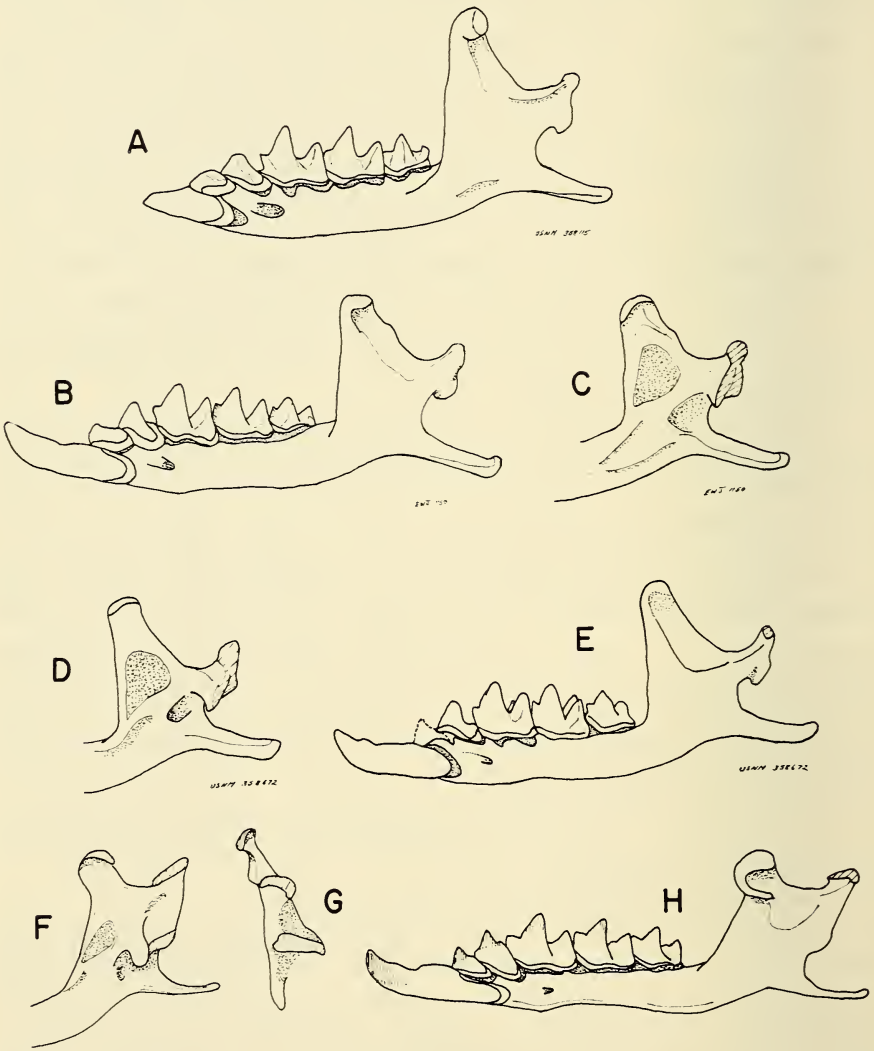

Fig. 1. A, Mandible, type of *Crocidura horsfieldi kurodai* n. ssp., (USNM 358115); B & C, Mandible, type of *Crocidura russula hosletti* n. ssp., (USNM 398640) labial and lingual views respectively; D & E, Mandible, *Crocidura suaveolens* (Pallas, 1811), (USNM 358672) lingual and labial views respectively; F–H, Mandible of *Episoriculus fumidus* (Thomas, 1913) lingual, posterior and labial views respectively.

Crocidura horsfieldi tadae Tokuda and Kano

Crocidura horsfieldi (Tomes, 1857)

Jones, Lim and Cross, 1971:270; Jones, 1975:185.

Crocidura tadae Tokuda and Kano, 1936
Tokuda and Kano, 1936:429; Kuroda, 1938:84, 1939:45, 1940:184; Okada, 1938:2; Chen, 1956:49; 1969:349.
Crocidura horsfieldi tadae Tokuda and Kano, 1936
Ellerman and Morrison-Scott, 1951:76, 1966:76; Kuroda, 1952:286; Jones, Huang and Chang, 1969:49; Kuntz and Dien, 1970:33.

Crocidura tadae was described on the basis of six specimens from Lan Yu (i.e. Orchid Island or Kotôshô), southeast of Taiwan. Kuroda (1952) made *C. tadae* a subspecies of *C. horsfieldi*, and noted that it is not found on Taiwan proper. The habitat is described as farmyards and stone walls near houses (Tokuda and Kano, 1936).

Measurements (from type-description).—Total length (5 specimens) mean = 95.6 mm (range 91–101); tail (5) 42.2 (39–45); hind foot (6) 12.2 (11.5–12.8); skull measurements (Table 1).

Specimens examined.—Lan Yu: Imourod 22°04′N, 121°32′E (NSMT 4395).

Crocidura russula hosletti, new subspecies

Crocidura horsfieldi (Tomes, 1857)
Jameson, 1970:82.

Holotype.—Adult male, skin and skull, USNM 398640, from 10 mi W Taichung, Taichung Hsien, Taiwan; obtained 11 October 1963 by E. W. Jameson, Jr., original no. EWJ 1150.

Diagnosis.—Generally small; tail short.

Dorsal hairs tricolored, tips Dark Brown, middle portion lighter Dark Brown, and basal half very Dark Gray. Ventral hair of holotype Light Gray on throat and chest, with Dark Gray bases. Remainder of ventral pelage Grayish Brown with hairs unicolored to bases. Division of Light Gray and Grayish Brown portions rather abrupt, possibly a molt line. Tail only slightly bicolored; dorsum Dark Brown, venter lighter Dark Brown than dorsum; scales visible, although short hairs are rather numerous; bristles most abundant near base. Hind feet have Grayish Brown hairs dorsally.

USNM 358671 has similar characteristics except that throat and chest lack Light Gray coloration. USNM 358670 has a Dark Reddish Brown dorsum which is darker than the other two skins. It also has Light Gray throat and chest and tail bristles like holotype, but 358671 has bristles on basal 21% of tail. Skins of both 358670 and 358671 are preserved in fluid.

Skull small, condylo-incisive length short; mandible relatively short; height from condylar process to base short.

Measurements.—Total length (3 specimens) mean = 108.7 mm (range = 99–119); tail (3) 40.3 (39–42); hind foot (3) 13 (13); condylo-incisive length

Table 1. *Crocidura horsfieldi* measurements, $\bar{x}$ and range (number of specimens measured).

	Total length	Tail length	Hind foot length	Condylo-incisive length	Palatal length
C. h. kurodai	104	44	12(2)	—	6.3
Taiwan	97–110(2)	42–46(2)			6.1–6.5(2)
C. h. tadae	—	—	—	16.5(1)	6.6(1)
Lan Yu					
C. h. ssp.	95(1)	35(1)	11(1)	16.4(1)	6.5(1)
Fukien					
C. h. watasei	118	49.3	11.4	17.4	7.0
Ryukyus	112–123(3)	47–54(4)	11–12.2(4)	16.8–18.1(4)	6.6–7.5(4)
C. h. indochinensis	—	—	—	—	6.8(1)
Tonkin					
C. h. indochinensis	108	44.7	11.2	17.3	7.0
Burma	95–117(6)	42–47(6)	10–13(6)	17.1–17.6(5)	6.8–7.2(6)
C. h. indochinensis	114	49	12.8	—	—
Thailand	103–125(2)	48–50(2)	12.5–13(2)		
C. h. horsfieldi	116	49.9	11.7	16.7	6.5
Sri Lanka	111–120(10)	45–53(10)	10–15(11)	16.2–17.1(6)	6.4–6.7(9)
*C. h. wuchihensis**	—	—	10.3	—	—
Hainan			10–10.5(2)		

	Length UTR	Greatest breadth braincase	Least interorbital breadth	Greatest maxillary width	Height braincase
C. h. kurodai	7.1	7.7(1)	3.7(2)	5.2	4.2(1)
Taiwan	7.0–7.2(2)			5.1–5.3(2)	
C. h. tadae	7.4(1)	7.9(1)	3.9(1)	5.3(1)	4.1(1)
Lan Yu					
C. h. ssp.	7.0(1)	7.7(1)	3.8(1)	5.1(1)	4.0(1)
Fukien					
C. h. watasei	7.4	8.0	3.8	5.4	4.5
Ryukyus	7.1–7.9(4)	7.8–8.3(4)	3.5–4.1(4)	5.2–5.6(4)	4.3–4.7(4)
C. h. indochinensis	7.3(1)	—	4.0(1)	5.2(1)	—
Tonkin					
C. h. indochinensis	7.4	8.1	4.0	5.2	4.5
Burma	7.2–7.6(6)	7.9–8.3(6)	3.9–4.1(6)	5.1–5.3(6)	4.4–4.6(4)
C. h. indochinensis	7.7	8.1(2)	—	5.8	—
Thailand	7.5–7.8(2)			5.7–5.9(2)	
C. h. horsfieldi	7.0	7.5	3.6	5.1	4.3
Sri Lanka	6.7–7.3(9)	7.2–7.7(5)	3.5–3.8(9)	4.9–5.3(9)	4.2–4.3(5)
C. h. wuchihensis	—	7.8(2)	—	—	—
Hainan					

* Taken from type description (Shou et al., 1966).

Table 1. Continued.

	Length LTR	Height rostrum	Mandibular length	Length PM^4	Length I^1
C. h. kurodai Taiwan	5.2 5.0–5.3(2)	1.8 1.7–1.9(2)	—	1.8 1.7–1.8(2)	1.2 1.0–1.3(2)
C. h. tadae Lan Yu	5.2(1)	1.6(1)	10.0(1)	1.6(1)	1.0(1)
C. h. ssp. Fukien	4.8(1)	1.8(1)	9.9(1)	1.7(1)	1.1(1)
C. h. watasei Ryukyus	5.2 5.0–5.5(4)	1.9 1.8–2.1(4)	11.1 11.0–11.1(4)	1.6(4)	1.3 1.2–1.4(4)
C. h. indochinensis Tonkin	5.0(1)	2.0(1)	10.3(1)	1.7(1)	1.2(1)
C. h. indochinensis Burma	5.1 4.9–5.2(6)	1.9 1.8–2.0(6)	10.5 10.3–10.8(6)	1.7 1.6–1.7(6)	1.1 1.1–1.2(6)
C. h. indochinensis Thailand	—	—	—	—	—
C. h. horsfieldi Sri Lanka	4.9 4.6–5.0(10)	1.8 1.4–1.9(10)	9.9 9.5–10.5(10)	1.6 1.5–1.7(10)	1.2 1.0–1.3(10)
C. h. wuchihensis Hainan	—	—	—	—	—

	Width posterior edge of palatine	Length nasals
C. h. kurodai Taiwan	2.1(1)	4.8(1)
C. h. tadae Lan Yu	2.3(1)	5.4(1)
C. h. ssp Fukien	2.5(1)	4.9(1)
C. h. watasei Ryukyus	2.5 2.4–2.5(2)	6.0 5.9–6.1(2)
C. h. indochinensis Tonkin	2.5(1)	4.9(1)
C. h. indochinensis Burma	—	—
C. h. indochinensis Thailand	—	—
C. h. horsfieldi Sri Lanka	2.2 2.1–2.3(6)	4.8 4.2–5.4(6)
C. h. wuchihensis Hainan	—	—

Table 2. *Crocidura russula* measurements, $\bar{x}$ and range (number of specimens measured).

	Total length	Tail length	Hind foot length	Condylo-incisive length	Palatal length
C. r. hosletti	108.7 99–119(3)	40.3 39–42(1)	13(3)	17.8(1)	7.1 6.9–7.1(4)
C. r. quelpartis	114 98–131(8)	45.8 39–48(8)	13 12–15(8)	18.9 18.3–19.6(8)	7.2 7.0–7.3(8)
C. r. chisai	123(1)	43(1)	15(1)	18.9(1)	7.1(1)
C. r. rapax	118 111–125(2)	47(2)	13.5 13–14(2)	17.7(1)	6.9 6.8–6.9(2)
C. r. vorax	113.7 108–125(3)	49 43–57(3)	12.3 12–13(3)	18.1 17.8–18.4(2)	7.3 7.0–7.7(3)
C. r. pullata	129.8 121–137(14)	45.4 40–50(14)	15 14–16(13)	20 19.4–20.4(8)	8.3 8.0–9.2(13)
C. r. russula	106.5 104–111(4)	40.8 38–43(4)	12.2 12–12.5(4)	20.3 19.5–20.6(4)	—

	Length UTR	Least interorbital breadth	Greatest breadth braincase	Greatest maxillary width	Height braincase
C. r. hosletti	7.7 7.5–7.9(4)	4.0 3.9–4.0(4)	8.2(3)	5.6 5.6–5.7(4)	4.6 4.5–4.7(3)
C. r. quelpartis	7.7 7.5–8.0(8)	4.0 3.9–4.1(8)	8.3 8.0–8.6(8)	5.7 5.5–5.8(8)	4.5 4.2–4.7(8)
C. r. chisai	7.6(1)	4.0(1)	8.5(1)	5.7(1)	4.5(1)
C. r. rapax	7.5 7.4–7.5(2)	3.6 3.5–3.7(2)	7.6(1)	5.2 4.9–5.4(2)	4.5(1)
C. r. vorax	7.9 7.4–8.0(3)	4.0 3.9–4.0(3)	8.5 8.4–8.5(2)	5.7 5.5–5.9(3)	4.6 4.5–4.7(2)
C. r. pullata	8.9 8.5–9.3(13)	4.4 4.2–4.5(12)	9.2 8.9–9.7(10)	6.2 6.0–6.4(13)	4.6 4.5–4.7(6)
C. r. russula	8.9 8.7–9.0(4)	4.1 4.0–4.3(4)	9.2 8.8–9.5(4)	6.4 6.3–6.5(4)	4.8 4.6–4.9(4)

(1) 17.8; palatal length (3) 7.1 (6.9–7.1); greatest breadth braincase (3) 8.2 (8.2); length upper tooth row (3) 7.7 (7.5–7.9); greatest maxillary width (3) 5.6 (5.6–5.7); least interorbital width (3) 4.0 (3.9–4.0); height of braincase (3) 4.6 (4.5–4.7); length of lower tooth row (3) 5.2 (5.0–5.4); length of PM4 at cingulum (3) 1.8 (1.8); width of posterior edge of palate (2) 2.5 (2.5);

Table 2. Continued.

	Length LTR	Height rostrum	Length PM^4	Length I^1	Width posterior edge of palatine
C. r. hosletti	5.2 5.0–5.4(4)	1.9 1.8–2.0(4)	1.8(4)	1.3 1.3–1.4(4)	2.4 2.3–2.5(3)
C. r. quelpartis	5.2 5.1–5.4(8)	1.8 1.6–2.0(8)	1.8 1.7–1.8(8)	1.1 1.1–1.2(8)	2.3 2.2–2.4(8)
C. r. chisai	5.3(1)	1.7(1)	1.7(1)	1.1(1)	2.5(1)
C. r. rapax	5.1(1)	1.9 1.8–1.9(2)	1.8(2)	1.1(2)	2.4 2.3–2.4(2)
C. r. vorax	5.5 5.3–5.8(2)	1.8 1.8–1.9(3)	1.8(3)	1.2(3)	2.3 1.8–2.6(3)
C. r. pullata	6.1 5.9–6.3(14)	1.9 1.8–2.0(13)	2.0 2.0–2.1(14)	1.3 1.1–1.5(13)	2.8 2.0–3.0(13)
C. r. russula	6.1 6.0–6.2(4)	1.9 1.7–2.0(4)	2.0 1.9–2.0(4)	1.3 1.2–1.4(4)	2.8 2.7–2.9(4)

	Mandibular length	Top of condylar process to base	Infraorbital foramen to anterior point premaxilla	Length infraorbital canal
C. r. hosletti	10.9 10.7–11.1(4)	3.8(4)	4.8 4.6–5.0(4)	0.7 0.6–0.9(4)
C. r. quelpartis	11.4 11.1–11.8(8)	4.2 4.0–4.6(8)	4.9 4.7–5.1(8)	0.6 0.5–0.7(8)
C. r. chisai	11.2(1)	4.0(1)	4.7(1)	0.8(1)
C. r. rapax	10.6 10.5–10.6(2)	3.9 3.7–4.0(2)	4.4 4.3–4.5(2)	0.7 0.6–0.7(2)
C. r. vorax	11.3 10.9–11.8(3)	4.0 3.9–4.0(2)	4.6 4.4–4.7(2)	0.9(2)
C. r. pullata	12.5 12.2–12.9(13)	4.5 4.4–4.8(13)	5.5 5.4–5.9(13)	0.8 0.6–0.8(14)
C. r. russula	12.8 12.2–13.2(4)	5.0 4.7–5.2(4)	6.2 5.8–6.5(4)	0.8 0.8–0.9(4)

height of rostrum (3) 1.9 (1.8–2.0); length of I1 at cingulum (3) 1.3 (1.3–1.4); distance from infraorbital foramen to anterior point of premaxilla (3) 4.8 (4.6–5.0).

Comparison.—Dorsal coloration of the holotype is the same as Allen

(1938) described for *C. vorax* (= *C. russula vorax*). However, USNM 358670 appears closest to *C. suaveolens phaeopus* (AMNH 56010, 56017, 56021, 56026, 56038).

Allen (1938) described the venter of *C. russula* as like that of *C. r. hosletti*, whereas *C. suaveolens* had hairs of the venter "white-tipped," "whitish-gray" and "white." However, venters of the above specimens of *C. suaveolens phaeopus* in the AMNH are similar to *C. r. hosletti*. AMNH 56010 and 56026 have gray throats and chests as do the holotype of *C. r. hosletti* and USNM 358670.

Tails of other subspecies of *C. russula* are more distinctly bicolored than *C. r. hosletti*, as are those of *C. suaveolens*. Distribution of tail bristles is variable in the subspecies of *C. russula* studied (our observations and published descriptions).

The skull of *C. r. hosletti* is generally smaller than in other subspecies of *C. russula* (Table 2), although close to *C. r. quelpartis*, *C. r. vorax* and *C. r. rapax*. The palatal shape of *C. r. hosletti* is essentially the same as *C. r. quelpartis*, but the skull of the former is shorter and narrower and the braincase higher than in the latter. The braincase of *C. r. hosletti* is narrower than in *C. r. vorax*; that of *C. r. rapax* is narrower than in *C. r. hosletti*. The shape of the palate of *C. r. vorax* is similar to that of *C. r. hosletti*, but that of *C. r. rapax* is shorter and narrower than both. The mandible of *C. r. hosletti* (Fig. 1B and C) reflects the relationships described above, being larger than in *C. r. rapax*, and smaller than in *C. r. vorax* or *C. r. quelpartis*.

Generally, *C. r. hosletti* is midway in size between *C. r. vorax* and *C. r. rapax*; *C. r. hosletti* is similar to *C. r. quelpartis* but somewhat smaller. The color of *C. r. hosletti* is closest to that described for the type of *C. r. vorax* (Allen, 1923) except that the tail is not distinctly bicolored. Allen (1923) described the ear of *C. r. vorax* as small and "less conspicuous than usual"; the ears of *C. r. hosletti* are relatively large and conspicuous.

Biology.—*C. r. hosletti* was found (EWJ) to be common in cultivated fields in lowlands of Taichung Hsien, where it apparently outnumbers *C. attenuata*. It was reproductively active in February when 3 gravid females were collected. Two had 3 embryos and the other had 4 embryos. None was nursing.

Etymology.—This subspecies is named to honor our friend, the late Professor Sherman A. Hoslett.

Specimens examined.—*Taipei Hsien*, Tamsui 25°10′N, 121°26′E (USNM 358670). *Taichung Hsien*: 10 mi W Taichung 24°10′N, 120°38′E (USNM 398640). Taiwan (Not specific) (USNM 358671).

Crocidura suaveolens (Pallas, 1811)

This is the first report of *C. suaveolens* from Taiwan. The only known specimen is a skull (USNM 358672) collected in a bamboo forest, near

Table 3. *Crocidura suaveolens* measurements, $\bar{x}$ and range (number of specimens measured).

	Palatal length	Length UTR	Least interorbital breadth	Greatest maxillary width	Length LTR
C. suaveolens Taiwan	6.9(1)	7.4(1)	3.7(1)	5.5(1)	5.3(1)
C. s. shantungensis	—	—	—	5.3(1)	5.3(1)
C. s. phaeopus	6.6 6.3–7.1(16)	7.2 7.0–7.7(14)	3.6 3.4–3.8(17)	5.0 4.8–5.1(17)	5.0 4.7–5.4(20)
C. s. ilensis	7.0(1)	7.4(1)	3.9(1)	5.1(1)	5.2(1)
C. s. lignicolor	8.1(1)	8.5(1)	4.5(1)	6.1(1)	6.1(1)

	Height rostrum	Mandibular length	Length PM^4	Length I^1	Width posterior edge of palatine
C. suaveolens Taiwan	1.9(1)	10.5(1)	1.7(1)	1.3(1)	2.4(1)
C. s. shantungensis	1.7(1)	—	1.8(1)	—	2.4(1)
C. s. phaeopus	1.6 1.5–1.8(30)	9.8 9.7–10.2(10)	1.7 1.6–2.1(20)	1.1 1.0–1.3(20)	2.4 2.1–2.9(17)
C. s. ilensis	1.7(1)	—	1.7(1)	1.2(1)	2.1(1)
C. s. lignicolor	2.0(1)	—	1.9(1)	1.2(1)	1.9(1)

	Top of condylar process to base	Infraorbital foramen to Anterior point of premax	Infraorbital canal length
C. suaveolens Taiwan	3.7(1)	4.8(1)	0.7(1)
C. s. shantungensis	3.9(1)	4.3(1)	0.5(1)
C. s. phaeopus	3.6 3.2–4.1(20)	4.3 3.8–5.0(19)	0.6 0.5–0.9(19)
C. s. ilensis	3.8(1)	4.2(1)	0.6(1)
C. s. lignicolor	4.3(1)	5.2(1)	0.8(1)

Feng ChiHu, 1,440 m. The cranial and mandibular measurements (Table 3) are close to but slightly smaller than those of *C. russula hosletti*. Massiveness of the ramus is the most useful character separating *C. suaveolens* and *C. russula* (Fig. 1D and E). As stated by Ognev (1962), the lower jaw of *C. suaveolens* is "much weaker, more slender and smaller than in . . ." *C. russula*.

Generally, the specimen of *C. suaveolens* from Taiwan is larger than *C. s. phaeopus*, *C. s. shantungensis* and *C. s. ilensis* and smaller than *C. s. lignicolor* (Table 3). *C. suaveolens* from Taiwan is larger than its geographically closest relatives, *C. s. phaeopus* and *C. s. shantungensis*, in the following characters: greatest maxillary width, height rostrum, length of rostrum from anterior edge of infraorbital canal to anterior tip of premaxilla and mandibular length.

Discovery of this species and *C. russula* on Taiwan adds two more Palearctic species to the island fauna. More intensive collecting for small shrews on the island may yield additional material of *C. suaveolens* on which a more comprehensive description can be based.

Measurements.—Table 3.

Specimens examined.—Chiai Hsien: Feng Chi Hu 23°30′N, 120°41′E (USNM 358672).

Suncus murinus (Linnaeus)

Sorex murinus Linnaeus, 1766
Swinhoe, 1870:620.
Crocidura murina (Linnaeus, 1766)
Aoki, 1913:272, 1914:30; Horikawa, 1925:224.
Suncus murinus (Linnaeus, 1766)
Horikawa, 1925:233; Kuroda, 1925:2; Chen, 1956:48, 1969:349; Jones, Huang, Chang, 1969:49; Kundin et al., 1972:270; Kuntz and Dien, 1970: 33; Jones, Lim and Cross, 1971:269; Jones, 1975:185.
Crocidura (*Pachyura*) *murina* (Linnaeus, 1766)
Aoki, 1930:13, 1933:79; Tanaka, 1936:311; Tateishi, 1938:516.
Suncus murinus murinus (Linnaeus, 1766)
Ellerman and Morrison-Scott, 1951:65, 1966:64.
Sorex myosurus Pallas, 1785
Swinhoe, 1864:382.
Crocidura caerulea (Shaw, 1800)
Horikawa, 1925:224.
Suncus caeruleus (Shaw, 1800)
Kuroda, 1925:1; Harrison and Audy, 1951:179.
Suncus murinus swinhoei (Blyth, 1859)
Kuroda, 1952:285.
Pachyura swinhoei (Blyth, 1859)
Gee, 1929–1930:52.
Crocidura murina swinhoei (Blyth, 1859)
Horikawa, 1932b:249.
Crocidura (*Pachyura*) *murina swinhoei* (Blyth, 1859)
Takashima, 1930:199; Horikawa, 1932a:35.
Suncus myosurus swinhoei (Blyth, 1859)
Okada, 1938:2; Kuroda, 1938:81, 1940:177.

Crocidura muschata Hatori, 1915
Hatori, 1915:57, 1919:234.

Suncus murinus commonly occurs in houses and other buildings as well as open city sewers, livestock pens, etc. It is less common in cultivated areas near houses. We found it only below 300 m. McNeill et al. (1968) found this species living in the coral rock walls near the villages of MaKung, Peng Hu Hsien (Pescadores). Mao (1970) reported that the habu viper (*Trimeresurus mucrosquamatus*) is a predator of *Suncus murinus*.

Measurements.—Total length males (7 specimens) mean = 211.9 mm (191–223), females (4) 191.3 (184–198); tail males (7) 80.3 (70–89), females (4) 71.3 (67–78); hind foot males (7) 21.6 (20–23), females (4) 20.3 (20–21).

Specimens examined.—*Chang Hua Hsien*: Hua-Tan 24°02′N, 120°32′E (USNM 313633, 313634, 313635); Chi Hu 23°58′N, 120°28′E (USNM 332818); Pu Yen 24°00′N, 120°28′E (USNM 313650); Shan Sheng (?coordinates) (USNM 313640, 313641, 313646, 313647, 313648, 313649). *Hsin Chu Hsien*: Pei Pu 24°42′N, 121°03′E (USNM 313643, 313644). *Hualien Hsien*: 3 mi SW Hualien 23°58′N, 121°36′E (USNM 330006, 330007, 330008, 330009). *Kaohsiung Hsien*: Tsoying 22°41′N, 120°17′E (USNM 294134, 294135, 356347, 356348); Mei Nung 22°54′N, 120°32′E (USNM 332819). *Peng Hu Hsien*: Hu Hsi 23°35′N, 119°39′E (USNM 294136, 294137, 294138); Lin Tou 23°34′N, 119°38′E (USNM 332820, 332821, 332822); Pachnau 23°22′N, 119°29′E (USNM 294728, 294542, 294543); Gyoo-To 23°36′N, 119°30′E (USNM 294559, 294560, 294561, 294562, 294563); (no specific locality) (USNM 294557, 294558, 294564, 294565, 294566, 294567, 330016, 330017, 330018, 330019, 332823, 332824). *Ping Tung Hsien*: Chao Chow 22°33′N, 120°32′E (USNM 297862, 299956, 313637, 332816, 332817, 330001, 356350); San Hsing 22°33′N, 120°33′E (USNM 356349). *Taichung Hsien*: Ma-an Liao, 6 mi S. Tung Hsi 24°15′N, 120°49′E (USNM 294130); Taichung 24°09′N, 120°41′E (USNM 294131); 4 mi SE Taichung (USNM 294132, 294133). *Taipei Hsien*: Ali Lao 25°17′N, 121°36′E (USNM 330004, 330005); Pei Tou 25°08′N, 121°29′E (USNM 313638, 313639); Shih Lin 25°05′N, 121°31′E (USNM 313645); Tien Mou 25°05′N, 121°31′E (USNM 330010, 330011, 330012, 330013, 330014, 330015); Taipei 25°03′N, 121°30′E (USNM 305926, 305927, 305928, 305929, 305930, 305931, 305932, 305933, 308418, 308419, 308420, 308421, 308422, 308520, 313631, 313632, 313636, 313642, 313651, 330002, 330003, 332815, 358116, 358129). Tamsui 25°10′N, 121°26′E (USNM 358117, 358118, 358119, 358120, 358121, 358122, 358123, 358124, 358125, 358126, 358127, 358128, 358130).

Literature records.—*Chiai Hsien*: 23°29′N, 120°27′E (Kuroda, 1925, 1938). *Peng-Hu Hsien*: Makung 23°34′N, 119°34′E (McNeill et al., 1968). *Tainan Hsien*: Tainan 23°00′N, 120°11′E (Kuroda, 1938). *Taipei Hsien*: Yangmingshan 25°09′N, 121°33′E (McNeill et al., 1968). *Miao-Li Hsien*:

Chu-Nan 24°41′N, 120°52′E (Kundin et al., 1970). *Tao Yuan Hsien* (Mao, 1970).

Episoriculus fumidus (Thomas)

Soriculus caudatus (Horsfield, 1851)
Jones, Lim and Cross, 1971:269.
Soriculus fumidus Thomas, 1913
Thomas, 1913:216; Aoki, 1913:270, 1914:30; Horikawa, 1925:224, 1932a: 13, 1932b:249; Cabrera, 1925:125; Tanaka, 1936:311; Kuroda, 1938:80, 1940:174; Okada, 1938:3; Chen, 1948:41, 1956:47, 1969:349; Kuntz and Dien, 1970:33.
Soriculus caudatus fumidus Thomas, 1913
Ellerman and Morrison-Scott, 1951:59, 1966:59; Kuroda, 1952:285; Jones, Huang and Chang, 1969:48.
Episoriculus fumidus (Thomas, 1913)
Jameson, 1970:80; Jones, 1975:184.
Chodsigoa sodalis Thomas, 1913
Thomas, 1913:217; Aoki, 1913:270, 1914:30; Horikawa, 1925:224, 1932a: 13, 1932b:249; Cabrera, 1925:127; Kuroda, 1938:80; Okada, 1938:3; Chen, 1948:42, 1956:48, 1969:349; Ellerman and Morrison-Scott, 1951: 61, 1966:61; Jones, Huang and Chang, 1969:48; Jones, 1975:184.

Thomas (1913) described this shrew from a series of skins and skulls from Alishan, Chiai Hsien, placing it in the genus *Soriculus.* Is is common and widely distributed in the mountains. Taken primarily in hardwood and coniferous forests above 1,000 m, it has also been collected in dwarf bamboo on Ho Huan Shan, 3,200 m. Although many specimens were examined, no gravid females were found.

Ellerman and Morrison-Scott (1951) established the subgenus *Episoriculus* on the basis of size, proportions, and certain external features; they included the species *S. caudatus* and *S. leucops*, but questioned the placement of *fumidus.* On the basis of mandibular and dental characters, Repenning (1967) elevated *Episoriculus* to generic level and illustrated some important cranial features of *Episoriculus caudatus.* Kuroda (1925) intimated that *E. fumidus* might be a subspecies of *E. caudatus*, but a comparison of our specimens with Repenning's (1967) illustration shows that the mandible of *E. fumidus* differs from that of *E. caudatus* in having the angular process quite long and curved and a high coronoid process with converging sides (Fig. 1F and H). The lower incisor is long and in this respect *E. fumidus* resembles *Neomys.* Thus *E. fumidus* is clearly different from *E. caudatus* and in most respects fits comfortably into Repenning's (1967) description of *Episoriculus.*

Along with the original series of *E. fumidus* was a skull (without an accompanying skin) which Thomas (1913) described as the holotype of *Chodsigoa sodalis*. This skull was placed in *Chodsigoa* because it lacked the fourth upper unicuspid which is characteristic of *Soriculus* (and now *Episoriculus*). Thomas (1913) closed the description of *Chodsigoa sodalis* with the following comment. "Its external appearance is probably not very dissimilar from that of the other Arizan shrew, *Soriculus fumidus*, as Mr. Goodfellow brought home the typical skull as being just an extra skull of that species." In many efforts at Alishan and other seemingly appropriate sites, we have failed to find *Chodsigoa sodalis*, and have concluded that *C. sodalis* was based on an aberrant specimen of *E. fumidus*. Dr. G. A. Corbet (BMNH) has examined the types of both species and informs us that they seem indistinguishable except for the rudimentary unicuspid and a difference in age.

Measurements.—Total length males (8 specimens) mean = 112.1 mm (range = 105–126), females (9) 111.1 (103–128); tail males (8) 47.0 (45–50), females (9) 48.0 (44–52); hind foot males (7) 13.1 (12–14), females (9) 12.8 (11–14); condylo-incisive length (1) 18.1; greatest breadth braincase (2) 9.5 (9.5); length upper tooth row (2) 7.8 (7.5–8.0).

Specimens examined.—Chiai Hsien: Alishan 23°32′N, 120°48′E (USNM 261036, 332804, 332805, 332806, 332807, 332808, 332809, 332810, 358108); 0.1 km E Alishan Station (USNM 358108); 0.2 km E Alishan Station (USNM 358657); Wu-feng (2,500 m), 10 km SW Alishan (EWJ 1158) 2 km W Alishan (USNM 358658). *Nantou Hsien*: Wushe 24°02′N, 121°08′E (USNM 332811, 332812), Yin Feng, Wushe (USNM 332802, 332803); Chuei Feng 24°05′N, 121°11′E (USNM 332800, 332801); Ho Huan Shan 24°09′N, 121°16′E (USNM 358659, 358580).

Literature records.—Nantou Hsien: Lung Yuen, 5 km SW Wushe (Philipps, 1966); 24 km E Wushe (Jameson, 1970), 32 km NE Wushe (Jameson, 1970). *Taichung Hsien*: Lishan 24°15′N, 121°15′E (Jameson, 1970).

Chimarrogale himalayica (Gray, 1842)

Chimarrogale himalayica was first reported and fully described from Taiwan by Jones and Mumford (1971). Four specimens were collected in boulder strewn mountain streams near the villages of Pei Chang and Meichi, Nantou Hsien.

Measurements.—Total length males (2 specimens) mean = 122.5 mm (range = 115–130), females (2) 110 (109–110); tail males (2) 85 (80–90), females (2) 96.5 (92–101); hind foot males (2) 26 (25–26), females (2) 23 (23); condylo-incisive length males (2) 25.0 (24.9–25), females (2) 24.8 (24.6–25.0); length upper tooth row males (2) 11.2 (11.0–11.3), females

(2) 11.0 (10.9–11.1); greatest breadth braincase males (2) 12.9 (12.9), females (2) 12.9 (12.8–13.0); greatest maxillary width males (2) 7.9 (7.8–7.9), females (2) 7.6 (7.5–7.6); height braincase males (2) 6.7 (6.6–6.7), females (2) 6.8 (6.7–6.8).

Specimens examined.—*Nantou Hsien*: Pei Chang Chi (stream) 24°02′N, 120°51′E (RMNH 20963); Meichi (stream) 23°59′N, 120°54′E (USNM 358139, 358140, 358141).

Anourosorex squamipes yamashinai Kuroda

Anourosorex squamipes Milne-Edwards, 1872
Jones, Lim and Cross, 1971:269; Jones, 1975:186.
Anourosorex squamipes yamashinai Kuroda, 1935
Kuroda, 1935:288, 1938:85, 1940:187, 1952:286; Tanaka, 1936:313; Okada, 1938:3; Chen, 1948:46, 1956:49, 1969:349; Ellerman and Morrison-Scott, 1951:87, 1966:87; Jones, Huang and Chang, 1969:50; Kuntz and Dien, 1970:33; Jameson, 1970:82.

This shrew was first found in Taiwan by Kuroda (1935), who described it as an endemic subspecies. It apparently occurs throughout the forested mountains from about 300 m (the subtropical zone of Kuroda, 1952) to above timberline at elevations of more than 3,000 m (subarctic zone of Kuroda, 1952). This shrew is most abundant in hardwood forests between 1,500 and 2,500 m (upper temperate zone of Kuroda, 1952). It has also been captured in a cornfield near Wushe and in streamside secondary growth near Meichi. At the upper limits of its distribution it inhabits bamboo-covered slopes where it was captured in surface runways of *Microtus kikuchii*. There the bamboo seldom exceeds 30 cm in height.

Measurements.—Total length males (13 specimens) mean = 105.2 mm (range = 95–113 mm), females (10) 99.6 (90–109); tail males (13) 10.2 (7–11), females (10) 9.8 (8–12); hind foot males (13) 15.3 (13–18), females (10) 14.9 (10–16.6); condylo-incisive length males (4) 25.2 (24.6–26.2), females (2) 25 (24.3–25.7); palatal length males (5) 10.6 (10.1–11.3), females (2) 11.1 (10.5–11.6); greatest breadth braincase males (5) 13.3 (12.3–13.8), females (1) 13.2; length upper tooth row males (6) 11.2 (10.6–12), females (2) 11.3 (11.1–11.4).

Specimens examined.—*Chiai Hsien*: Alishan 23°32′N, 120°48′E (USNM 261040, 261041, 261042, 261043, 261044, 261045, 261046, 261047, 332828, 332829); 0.1 km E Alishan Station (USNM 358132, 358133, 358134); 0.2 km E Alishan Station (USNM 358135); Feng Chi Hu 23°30′N, 120°41′E (USNM 358136, 358137). *Nantou Hsien*: Wushe 24°02′N, 121°08′E (USNM 332825, 332826, 332830); 4.1 km W and 2.7 km S Wushe (USNM 358131); Chuei feng 24°05′N, 121°11′E (USNM 332831); Meichi 6 km W Wushe 23°59′N, 120°54′E (USNM 358138); Sung Kong forest (?coordinates) (BPBM 171).

Literature records.—Ilan Hsien: Taiheizan (presently known as Taipingshan) 24°30′N, 121°38′E (Kuroda, 1935). *Nantou Hsien*: 10 mi E Wushe (Jameson, 1966).

Key to Skulls of the Soricidae of Taiwan

1a. Seven teeth in upper tooth row (= 14) *Anourosorex squamipes yamashinai*
1b. More than seven teeth in upper jaw 2a
2a. Nine teeth in upper jaw (= 18) *Suncus murinus*
2b. Eight teeth in upper jaw (= 16) 3a
3a. Tips of teeth pigmented, chestnut *Episoriculus fumidus*
3b. Tips of all teeth white 4a
4a. Skull more than 24 mm long *Chimarrogale himalayica*
4b. Skull less than 23 mm long *Crocidura* 5a
5a. Upper tooth row longer than 8.5 mm *Crocidura attenuata tanakae*
5b. Upper tooth row shorter than 8.0 mm 6a
6a. Greatest maxillary width less than 5.4 mm 7a
6b. Greatest maxillary width more than 5.4 mm 8a
7a. Occurring on main island of Taiwan *Crocidura horsfieldi kurodai*
7b. Occurring on Lan Yu *Crocidura horsfieldi tadae*
8a. Mandibular length measuring 10.5 mm or less *Crocidura suaveolens*
8b. Mandibular length exceeding 10.6 mm *Crocidura russula hosletti*

Key to Skins of the Soricidae of Taiwan

1a. Tail shorter than hind foot *Anourosorex squamipes yamashinae*
1b. Tail longer than hind foot 2a
2a. Edges of feet and tail with fringes of stiff hairs *Chimarrogale himalayica*
2b. Edges of feet and tail without fringes of stiff hairs 3a
3a. Tail with long bristles 4a
3b. Tail without long bristles *Episoriculus fumidus*
4a. Hind foot longer than 20 mm *Suncus murinus*
4b. Hind foot shorter than 15 mm *Crocidura* 5a
5a. Tail bristles limited to proximal third of tail *Crocidura horsfieldi* 6a
5b. Tail bristles occurring over more than proximal third of tail 7a
6a. Occurring on main island of Taiwan *Crocidura horsfieldi kurodai*
6b. Occurring on Lan Yu *Crocidura horsfieldi tadae*
7a. Tail longer than 45 mm; total length greater than 120 mm *Crocidura attenuata tanakae*
7b. Tail shorter than 45 mm; total length less than 120 mm *Crocidura russula kurodai*

Discussion

Taiwan lies off the coast of the Chinese mainland where the Palaearctic and Oriental Regions interdigitate over a broad front. The lowlands of Taiwan are subtropical and the shrews, *Crocidura* and *Suncus*, inhabiting this climatic region are widespread in the Old World. Mountains rise sharply from near the eastern seacoast to treeless alpine slopes of dwarf bamboo at 3,200 m and more. Four vegetative zones occur in the mountains, from the plains which are extensive on the western part of the island to the high ridges on the east (Tsukada, 1966); shrews occur over a wide range of elevations. *Chimarrogale himalayica* is confined to lower elevations in the mountains presumably by virtue of being restricted to streams of moderate speed that flow through the narrow mountain valleys. *Anourosorex squamipes* occurs from warm temperate forests of *Cunninghamia konishii*, *Podocarpus macrophyllus* and *Cephalotaxus wilsonia* with a continuous distribution to above the boreal forests of *Tsuga chinensis*, *Abies kawakamii* and *Picea morrizonicula*. *Episoriculus fumidus* lives in forests, open grasslands, and dwarf bamboo from approximately 1,800 m to at least 2,300 m. *Crocidura attenuata*, as noted above, occurs in the subtropical lowlands, but also ranges to 1,225 m. Similarly, *Crocidura horsfieldi kurodai* ranges from about sea level to above 1,200 m. The little known *Crocidura russula* and *Crocidura suaveolens* are only known to occur in the lowlands and mountains, respectively, and both are Palearctic in distribution.

Under the cooling effects of the Pleistocene, the vegetative zones extended into lower elevations. During the Tali Glacial Age (equivalent to the early Wisconsin period of North America), the boreal coniferous forests, which now occur above 2,400 m, were at 750 m (Tsukada, 1966). This suggests a drop of 8° to 11°C in the mean annual temperatures (Tsukada, 1966). During this period, Taiwan was connected to the mainland (Tsukada, 1966) at an estimated "glacial low stand" of –85 to –130 m (McIntyre et al., 1976); the Taiwan Strait is less than 100 m deep. Clearly, the climate was such that *A. squamipes*, the various species of *Crocidura*, and *Chimarrogale himalayica* could have migrated from the mainland to Taiwan, if they had not already existed on the island. *Anourosorex* occurred far to the north at this time and is known from the middle Pleistocene of Honshu, Japan (Shikama and Hasegawa, 1958). Tsukada (1966) noted at least two subsequent cool periods on Taiwan; the last, between ca 25,000 and 14,000 BP was characterized by a mean temperature drop from 2° to 6°C. Later (14,000 to 12,000 BP) there was a rise in the mean annual temperature to about 2° to 3°C above recent levels. One must presume that the drastic lowering of temperature during the Tali effected a total departure of *Suncus* from Taiwan, if it in fact occurred there prior to that time.

This suggests that the antiquity of the Taiwan shrews is greater than 14,000 BP. *Episoriculus fumidus* is presumably the oldest soricid resident on Taiwan and is the only species known to be endemic. *Anourosorex squamipes*, *Crocidura horsfieldi*, *C. russula* and *C. attenuata*, judging from their present altitudinal distribution, could have survived the Tali Age on Taiwan. Gene flow during the period of the land bridge would account for their affinity with mainland forms. *Chimarrogale himalayica* could have conceivably followed the same pattern, for its present known distribution extends to 750 m and its apparent close relationships with *C. himalayica leander* suggest a migration during the land connection during the Tali Age. The fact that *S. murinus* is always found in close relation with man's abodes lends credence to the theory that it entered with man; this association with man throughout southern Asia suggests the probability that there have been repeated introductions on Taiwan via cargo or human immigration.

This sequence of events could account for the low degree of endemicity among the shrews of Taiwan.

Acknowledgments

We thank the following individuals and their institutions for loaning comparative material used in our study: Dr. Sydney Anderson, AMNH, Dr. G. B. Corbet and Ms. P. D. Jenkins, BM(NH); (the late) Mr. Kitti Thonglongya, Applied Scientific Research Corp., Bangkok, Thailand; Drs. Y. Imaizumi and M. Yoshiyuki, NSMT; Dr. Luis de la Torre, FMNH; Dr. A. M. Husson, RMNH and Dr. Henry Setzer, USNM. We thank Drs. G. B. Corbet, David H. Johnson, and Charles A. Repenning for valuable suggestions during the study; Drs. John H. Cross and R. H. Watten, U.S. Naval Medical Research Unit #2, Taipei, for supporting parts of the field work, and Diana B. Jones for typing manuscript.

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